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August 1993

Final Report (92 to 93)

AD-A279 004



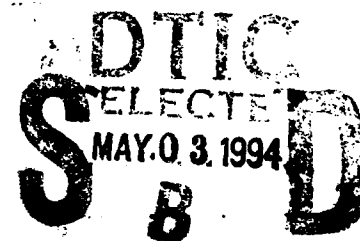
Medical Supply Systems: Alternatives for Brooke Army
Medical Center

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Brooke Army Medical Center (BAMC) is composed of two separate hospitals: Main Hospital and Beach Pavilion. Over the last few years, two different forms of medical supply distribution systems have evolved in the two institutions. Beach Pavilion is primarily serviced by a cart supply system whereas Main hospital uses a General Supply System (GSS) of supply on the wards (which involves the ordering and storage of supplies in rooms on the ward). With a new BAMC under construction (expected completion date of 1996), a decision must be made regarding the type of supply distribution system to be used in the new facility.

The purpose of this paper is to study the two different methods of supply delivery being used in BAMC wards and after quantitative analysis, recommend a supply delivery system for use in the new BAMC. The data for this study included ward location, the number of beds on the ward, the average number of patients on the ward, the number of nursing care hours expended, the number of assigned personnel and select medical supply data. After data collection from the 20 wards under study, normal parametric statistical analysis was used to analyze two hypotheses. It was determined that the type of distribution system used on the ward has no effect on the total money spent on supplies ($r = .03$, $p > .05$). However, when studying the amount of time expended for supplies on wards, it was determined that there was a statistically significant relationship between the type of distribution system in use and the total time spent maintaining supplies ($r = -.37$, $p < .05$). Recommendations were made to implement the Cart system of resupply in the New BAMC and to convert selected wards over to the cart system in accordance with the guidelines of the Department of Nursing.

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Supply, Cart, PAR

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**MEDICAL SUPPLY SYSTEMS:
ALTERNATIVES FOR BROOKE ARMY MEDICAL CENTER**

A Graduate Management Project

Submitted to the Faculty of

Baylor University

In Partial Fulfillment of the

Requirements for the Degree

of

Master of Health Administration

by

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U. S. Army

Graduation Date: August 1993

May 28, 1993

4590 **94-13154**


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ACKNOWLEDGMENTS

I would like to express my appreciation to everyone who helped me in the preparation and completion of my Graduate Management Project (GMP). Specifically, I would like to thank Colonel Covington for her help in interpreting the information required for the quantitative analysis of this project. Her guidance saved me considerable man-hours of study.

Colonel Croy and Colonel Graham were very instrumental in the rapid completion of this project and I would like to express my sincere appreciation for their support and help. Captain Ray Horn, my fellow resident and friend kept me going throughout my residency and always served as the voice of encouragement amidst the chaos. Mr. deWayne Beers provided the historical background about BAMC and was always available to help me with my project.

Finally, I would like to thank my preceptor (Colonel Douglas Barton) for giving me flexibility in my rotation schedule and for sharing his philosophy and ideas regarding my GMP. Colonel Barton's mentoring has provided me with executive management skills which I will use for the remainder of my career.

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ABSTRACT

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The data for this study included ward location, the number of beds on the ward, the average number of patients on the ward, the number of nursing care hours expended, the number of assigned personnel and select medical supply data. After data collection from the 20 wards under study, normal parametric statistical analysis was used to analyze two hypotheses. It was determined that the type of distribution system used on the ward has no effect on the total money spent on supplies ($r = .03$, $p > .05$). However, when studying the amount of time expended for supplies on wards, it was determined that there was a statistically significant relationship between the

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I. INTRODUCTION

Brooke Army Medical Center (BAMC) has operated in many different locations since post World War II when it underwent significant expansion to handle casualties from the war. Now, BAMC provides the majority of patient treatment from two facilities: Main Hospital and Beach Pavilion. Even though the two facilities operate under the same command, these two areas function as totally independent hospitals (each with its own intrinsic pharmacy, lab and x-ray support services). Many of the inpatient functions are duplicated between the two hospitals including Same Day Surgery (SDS), Medical Intensive Care wards, Surgical Intensive Care wards and miscellaneous Acute Care wards. Because of the physical separation between the two hospitals and the distance from the logistics support center, two different supply delivery methods have evolved. A new Brooke Army Medical Center is currently under construction.

Watts (1993) states that the third phase of the new BAMC construction began on February 11, 1992, is 25% completed (as of February 5, 1993) and has a final completion date of 1996. During this construction phase, there are many requests for changes to the design of the building based on organizational changes, technological changes (necessitating structural modifications) and financial considerations such as changes in the cost of materials. In order to help analyze and recommend changes in the building, the Corps of Engineers was assigned "Action Officers" from many

representative medical specialties including nursing, pharmacy, lab, x-ray and dietetics. These action officers are required to oversee specific areas of construction design in order to ensure the facility will be functional and integrated. By planning for structural changes at the beginning of the medical centers construction, the modifications can be implemented at a far lower cost than as a "retrograde implementation."

CONDITIONS WHICH PROMPTED THE STUDY

Two conditions prompted this study: 1. the possible requirement for construction modifications to the New Brooke Army Medical Center due to changes in the method of delivery of medical supplies to the wards and 2. a request by the Department of Nursing for a study to determine the most cost effective supply distribution system and identification of cost predictive variables.

Construction issues: During the construction of the hospital, a transition team was formed with responsibility for the smooth and orderly transition of services from the old BAMC site to the new BAMC site. Part of the mission of the transition team involves the analysis of systems which are currently in place at BAMC for the transition to the new facility. The delivery of medical supplies to hospital wards is a primary concern at this point in the construction process. With many different medical supply delivery systems in use at BAMC, an unbiased, scientific study of the subject would allow the transition team and the construction planners the

opportunity to implement needed design changes for the new BAMC. For example, if a decision was made to go totally to the cart system of resupply, additional dedicated elevator support might be needed. Also, the staging area for a large number of carts would be a planning consideration.

Nursing Operations Issues: On October 1, 1992, the BAMC Department of Nursing (DON) became the financial managers of the funds expended for treatment of patients at the various wards and clinics. With the newly acquired fiscal responsibility for supplies, the nursing department requested a study to determine cost effective procedures for ordering and delivering expendable medical supplies. Additionally, the Department of Nursing was interested in identifying variables which could be used to predict the dollar expenditure of supplies in the various wards. The units of measure for predictive calculations will include nursing acuity data, beds per ward, patient bed days, staffing considerations/patterns and data from the Workload Management System for Nurses (WMSN).

STATEMENT OF THE MANAGEMENT QUESTION

The following management questions are to be answered in this study: What medical supply delivery system would best fit the needs (monetarily and operationally) of the medical center? What variables could be used as effective predictors for the total amount of money spent on expendable supplies for a hospital ward?

LITERATURE REVIEW

The literature is replete with innovative systems for the delivery of medical supplies to clinics and wards. The sheer volume of literature available demonstrates that this area of medical material management has numerous opportunities to recapture costs and reclaim other financial benefits.

Lynch (1991) cites figures from the American Hospital Association which show that 33 percent of inpatient costs are for material and supplies. A review of spending trends over the last decade shows that U. S. hospital's expenditure for supplies has increased from \$8.3 billion in 1982 to \$9.6 billion in 1985 and continues to escalate (Griesler, D. S. and Aggarwal, S. C., 1987). In examining these costs, "it is estimated that for every dollar spent on acquiring a supply, an additional \$.70 to one dollar is spent on the logistics of moving the supply into the hands of the end user" (Lynch 1991, p.18). Often, the cost of delivery of supplies is duplicated. Lynch (1991) explained how both the hospital and the distributor duplicate the tasks of monitoring inventory, performing purchasing and receiving functions, tracking hospital usage functions and other administrative activities. He states that by eliminating such duplication, money can be saved by both the hospital and the vendor.

General Distribution Systems Review

Koselka (1992) studied the delivery of merchandise in businesses

outside of the medical field and described the phenomena she termed the "distribution revolution." In her article, Koselka explained how businesses are shifting their focus to make "distribution expense" a variable cost rather than a fixed cost. "In the 1970's and 1980's, increased automation and just-in-time techniques cut manufacturing costs dramatically. Financial engineering in the 1980's and early 1990's first replaced equity with debt to increase returns on equity, and now the reversal of the process has helped U.S. business to cut its capital costs" (p.58). Koselka then states that distribution costs often constitutes the single most controllable cost element in an organization. The author cites the following examples of business successes which were achieved by modifying material distribution schemes:

1. Helene Curtis has a new \$32 million facility with no paper "order tickets" or logically ordered inventory. Also, there is a lack of people in the plant due to the computer-controlled forklifts which read bar-codes and place packages on conveyors to ship to their destinations. With this single facility, the distribution costs to the company have been cut by 40% and twice as many goods are handled than were previously done in six older warehouses.

2. Mervyns department stores developed a task force of seven senior executives to investigate redoing the companies logistics and distribution system. By building four distribution centers and spending \$80 million to improve the distribution system, the average delivery time from vendor to

store was cut from 14 days to less than 9 days. As a result, carrying costs for Mervyns have not increased in the last five years and sales have increased by 50 percent.

3. Wal-Mart's *Sam's Clubs* use a different distribution scheme for the delivery of goods. This company uses the "warehouse" concept of distribution to further shorten the time and costs of moving goods from the maker to the consumer. The stores simply place the goods on pallets in the store and as a result, they cut the cost of overhead to extremely low levels. As a result, other retail outlets must find cost containment techniques in order to remain competitive.

The examples cited above show that "real savings" are available by implementing effective, efficient material distribution systems. Many companies have changed their management structure as a result of the new delivery systems. For example, Wal-Mart (as part of their cost cutting efforts) decided that "dealings should be directly with the principles" of the companies rather than middlemen (Koselka, 1992). This policy reflects Wal-Marts decision that middle management positions are often unnecessary and lead to inflated prices of the end products.

The Health Care Advisory Board (HCAB) is a for-profit membership association that conducts research and generates reports of special interest for financial and health care institutions. At a cost of over \$10,000 per year, the 3000 members are given access to thousands of studies which were

prepared for members on a case-by-case basis. One of the primary advantages of using HCAB involves their ability to access sensitive material (financial and operational information) about "for-profit" companies. Often, information is provided in HCAB reports that would not be available through any other source. In order to publish sensitive information, companies are often given aliases to maintain anonymity.

At BAMC's request, the Health Care Advisory Board (1992) conducted an in-depth review of various supply systems in order to ascertain the advantages and disadvantages of the various supply distribution systems. They assigned the major categories of replenishment systems as 1. Vendor Distribution Systems and 2. Automatic Replenishment Systems (see figure 1).

Insert Figure 1 about here

Vendor Distribution Systems: The Health Care Advisory Board (HCAB) defines four different forms of vendor distribution systems as a means of supplying hospitals. These systems are: 1. the consignment system, 2. the just-in-time inventory system, 3. the prime-vendor concept and 4. the stockless inventory system.

In the consignment system, the vendor owns the product until the product is used. In the past, this type of system has been used extensively

in areas such as the operating room where specialty products are utilized. For example, "an orthopedic hip replacement is in the possession of the vendor, not the hospital. When the hip replacement is utilized, it actually is sold to the patient by the vendor via the hospital" (ibid p. 2). The drawback to this type of delivery includes the continued requirement for storage space in the hospital.

In the Just-in-Time (JIT) delivery system, materials and goods are stored by the vendor and are delivered to the hospital at regular and frequent intervals (Cassak, 1988; Ackerman, 1988; Schmaus, 1990). Kowalski (1991) suggests that this form of distribution is borrowed from Japan in the late 1970's. Initially used in automobile and electronics manufacturing, the system began to be used by hospitals in the late 1980's. Prior to the 80's, the author states that hospitals had tried several tactics (including consignment) with varying degrees of success. HCAB (1992) cites the following characteristics of JIT systems:

- It is a useful method of reducing inventory costs because it eliminates the hospital supply room (cuts out the middle man).

- Supplies are delivered in the lowest unit of supply rather than in bulk.

- The hospital does not have to monitor inventory as closely. As a result, the storage space can be used for other purposes and overstocking is avoided.

-Although JIT eliminates storage space and reduces inventory costs, it does not reduce labor costs. The hospital must supply employees to break down the supplies, open the supplies and prepare them for delivery to the wards and clinics. Therefore, the same number of employees are needed to manage the delivery within the hospital.

Stockless inventory systems are often equated with the JIT systems described above (Eull, 1988; Patterson, 1990; Schmaus, 1990; Wagner, 1990 a, b, 1991). Kowalski (1991) stated that "fewer than 50 hospitals across the nation operate a true stockless program (in which hospital's storeroom has been terminated)" (ibid p.22). The author then states that supply exchange carts were in use by hospitals as early as 1975 when two hospitals contracted with a medical and surgical supply distributors to keep their carts filled. According to Kowalski, these were the first stockless programs used by hospitals. The author cites the following common characteristics of stockless inventory and JIT programs:

- Use of one or few suppliers;**
- Frequent ordering (enhanced by electronic means where possible);**
- Deliveries at least daily;**
- Basis in a long-term commitment; and**
- Use primarily with "stock" items.**

When compiling the differences between JIT and stockless inventory systems, Kowalski (1991) explains: 1. JIT may or may not involve the

smallest units of packaging where the stockless system does, 2. JIT can be a replenishment system for a storeroom (held in minimal supply levels) whereas the stockless system delivers direct to the department (without any additional personnel requirements on the part of the hospital), and 3. JIT programs reduce the size, scope, and inventory in a hospital's storeroom whereas the stockless program replaces the storeroom.

The last vendor distribution system cited by the HCAB (1992) is the Prime-Vendor Concept of resupply. In this system, a hospital selects a single provider to provide products and supplies in a certain supply category in an effort to reduce the number of vendors servicing the facility. This system simplifies administrative requirements but does nothing to decrease the amount of inventory used by the hospital. This system is used throughout the Army and is referred to as the General Supply System (GSS) in the remainder of this paper.

Automatic Replenishment Systems

According to HCAB (1992), there are two major types of automatic replenishment systems used in hospitals: the periodic automatic replenishment (PAR) system and the exchange-cart system (Ferdinand, 1989; Dennis & Emmet, 1992). Both systems are widely used in medical facilities throughout the United States.

The periodic automatic replenishment (PAR) system involves using a dedicated cart or area with permanent shelves, bins or closets in an

individual ward area. Designated individuals are required to maintain adequate stockage levels via ordering the supplies from one or more vendors. On a daily or "every other day" schedule, the inventory level is monitored and restocked as necessary (Anderson, 1992). The personnel responsible for maintaining the stocking level varies from institution to institution (from nursing personnel to supply personnel).

The cart-exchange system requires two sets of carts for each department or nursing unit. At the beginning of an exchange period (three to five times a week), stocked carts are taken to the applicable ward and exchanged for a partially depleted cart in order to maintain required supply levels on the ward. HCAB (1992) states that this system requires doubling the on-hand amount of supplies (thereby increasing the overhead).

Mr. Jack R. Anderson is the President of the Materials Resource Group in Raleigh, North Carolina. Prior to founding this consulting group, Mr. Anderson was employed as a materials manager in two different hospitals and is considered by HCAB (1992) as an expert in all of the supply replenishment systems currently in use throughout the United States. In an interview in 1992, Mr. Anderson stated that the type of supply system used by a hospital should be dependent upon the physical layout of the hospital. "If the hospital is structured vertically, the exchange system (aka cart system) is more efficient than the PAR system, as individual nursing units probably are not far from elevators. However, if a hospital is spread out over a large

area and is structured more horizontally, the PAR is faster and more efficient, as the material managers are not moving multiple sets of carts throughout the hospital " (Anderson, September, 1992).

In addition to the physical layout of the hospital, there are other factors which must be considered when comparing the two supply systems. Anderson cited the following additional considerations:

- The exchange-cart system doubles the hospital's inventory.
- The exchange-cart system is difficult to integrate into an operating room or emergency room due to the limited access to these areas.
- Both systems can become more efficient by utilizing bar-coding technology in order to do away with manual inventory tracking (Hansen et al, 1988; Wirwandt, 1989; Prokopczak, 1990).

Mr. Anderson concluded his interview by stating that more hospitals are abandoning the exchange-cart system for the PAR system. This change is basically due to the fact that hospitals no longer have available space for the storage of extra carts and supplies.

The Workload Management System for Nurses

The Army Field Manual FM 8-501 (November, 1990) gives a detailed account of the WMSN system and its applicability to nurse staffing and requirements projections. The system envelopes ten concepts. The system: 1. includes direct patient care time, 2. includes indirect patient care time, 3. is prospective, 4. is comprehensible but simple, 5. identifies required staff

time by level (RN, LPN, etc.), 6. provides time for unit administration and management, 7. is the basis for the determination of nursing manpower requirements in specific specialty areas including Med/Surg, Critical Care, Gyn, Peds, Neonatal, etc., 8. is reliable, 9. is valid and 10. is verifiable with inter-rater reliability built into the system. In developing the WMSN, nursing tasks were categorized and broken down into 99 critical indicators (activities which take more than 15 minutes per 24 hour period). Points are assigned to patients based on 1 point equaling 7.5 minutes of direct patient care. Patients are then placed into one of seven categories (see figure 2). Staffing pattern requirements for 24 hour coverage are assigned for wards based on existing charts found in the WMNS regulation.

Insert Figure 2. about here

PURPOSE

The purpose/objective of this study was to gather and analyze data related to the delivery and use of supplies on wards within Brooke Army Medical Center in order to determine the best system for use at the New Brooke Army Medical Center. The effect of the types of different medical distribution systems, patient acuity and nursing staffing patterns will be studied to determine their effect on the dependent variables of cost and time. In designing this project, two hypotheses are developed.

II. METHOD AND PROCEDURES

IDENTIFICATION OF MAJOR VARIABLES AND ISSUES

The above literature review demonstrates the importance of the two "outcomes of interest" which ultimately are used to determine the type of material distribution to be used in a business. The two outcomes of interest are *cost and time*. As a dependent variable, the *cost* of the medical material distribution system is influenced by many factors (independent variables) including the specific type of system used, the number of beds on a ward, the acuity of patients and the staffing on the ward. These same independent variables can effect the amount of *time* spent by ward personnel in managing supplies. The units of measurement for the independent variables would include data extracted from the Workload Management System for Nurses (WMSN).

HYPOTHESIS FORMATION

The quantitative analysis of this project began with two hypotheses. The hypotheses are stated as follows:

HYPOTHESIS #1 Dependent Variable: MONTOT

Independent Variable: MDSY

H₀: The type of distribution system (cart vs. GSS) used on a ward has no effect on the total money spent on supplies.

H_a: The amount of total money spent on supplies on a ward varies as a function of the type of medical supply distribution system in use.

HYPOTHESIS #2 Dependent Variable: TIMTOT

Independent Variable: MDSY

H₀: The type of distribution system (cart vs. GSS) used on a ward has no effect on the total time spent by ward personnel in securing supplies.

H_a: The total amount of time expended by nursing personnel in securing supplies on a ward varies as a function of the medical supply distribution system in use.

DEFINITION OF VARIABLES

In the course of this project, the following variables were used:

Dependent Variables

1. MONTOT- TOTAL MONEY SPENT FOR SUPPLIES

Data Source: BAMC Resource Management Division financial records from FY92.

Variable Units: Dollars (000)_

Variable Definition-The total amount of money expended for all categories of supplies on the specified ward for a period from March, 1992 to September, 1992. The starting date for data collection was set for March, 1992 due to the reorganization of several wards at Beach Pavilion. The end date for data collection was chosen as September, 1992 to coincide with the FY92 year end closeout. The MONTOT variable represents the sum of the following subcategories:

a. MDSAMTT- This is the sum of the money spent by the specified ward for supplies from the Material Distribution System. The MDS system is the primary source of supplies for those wards using the cart system of resupply.

b. LOGAMTT- This is the sum of the money spent for supplies for the specified ward from normal supply channels (also called GSS). This category of supplies includes administrative materials and some unique categories of medical equipment/expendable supplies.

c. CMSAMTT- This is the sum of the money spent for supplies for the specified ward from the Central Material Service. This category includes medical supplies which are required to be sterilized and require special processing.

2. TIMTOT- TOTAL TIME SPENT ON SUPPLIES

Data Source: Survey of Wards under the personal supervision of all wardmasters for the period of October 7, 1992 through October 30, 1992.

Variable Units: minutes

Variable Definition: The total amount of time spent by ward personnel in the procurement, stocking and administrative support of supply activities. The starting date was set based on mutual agreement between the primary investigator and the Chief, Department of Nursing, BAMC. The TIMTOT variable represents the sum of the following subcategories:

- a. **TIMREQ-** This is the total amount of time spent requisitioning supplies for the specified ward.
- b. **TIMSTOK-** This is the total amount of time spent stocking supplies on the specified ward.
- c. **TIMOTH-** This is the total amount of time spent on other activities in the supply distribution process for the specified ward. Examples in this category include making phone calls to check on the status of requisitions, time spent driving to pick up supplies etc.

Independent Variables

1. MAINY- MAIN YES

Data Source: Executive Officer, BAMC

Variable Units: Dichotomous Variable (1 denotes group membership, 0 denotes not a group member)

Variable Definition: Denotes location of the ward: code 1 if the ward is located in the Main Hospital, code 0 otherwise.

2. BEDNUM- BED NUMBERS

Data Source: C, Department of Nursing

Variable Units: Number of Beds

Variable Definition: Denotes the total number of available beds on the specified ward.

3. PTNUM- PATIENT NUMBERS

Data Source: Department of Nursing Information Systems

Office

Variable Units: Number of Patients

Variable Definition: Denotes the daily average number of patients on the specified ward for the period beginning March, 1992 through September, 1992.

4. NCHS- NURSING CARE HOURS REQUIRED

Data Source: Department of Nursing Information Systems

Office

Variable Units: Man-hours

Variable Definition: The number of hours of nursing care hours required for each category of patient based upon an assessment of their direct and indirect nursing care requirements in the workload management system for nurses (WMSN).

5. ACUITY- PATIENT ACUITY

Data Source: Department of Nursing Information Systems

Office

Variable Units: Acuity units

Variable Definition: The assignment of a patient to a category based on their nursing care requirements. The acuity of a patient is rated in one of seven categories from 0 to 6 (see figure 1).

6. ASPRO- ASSIGNED PROFESSIONAL NURSES

Data Source: Department of Nursing Information Systems

Office

Variable Units: Full Time Equivalents (FTE's)

Variable Definition: Denotes the average daily number of "Professional" (registered nurse) FTE's assigned to the specified ward for the period from March, 1992 through September, 1992.

7. ASPARA - ASSIGNED PARAPROFESSIONAL NURSES

Data Source: Department of Nursing Information Systems

Office

Variable Units: Full Time Equivalents (FTE's)

Variable Definition: Denotes the average daily number of "Para-professional" (all non-registered nurse personnel) FTE's assigned to the specified ward for the period from March, 1992 through September, 1992.

8. WMSREQ- WORKLOAD MANAGEMENT SYSTEM REQUIREMENT

Data Source: Department of Nursing Information Systems

Office

Variable Units: Full Time Equivalents (FTE's)

Variable Definition: Denotes the number of Nursing personnel required on a ward based on patient census and patient acuity.

9. MDSY- MATERIAL DISTRIBUTION SYSTEM YES

Data Source: BAMC Logistics Division (MDS)

Variable Units: Dichotomous Variable (1 denotes group membership, 0 denotes not a group member)

Variable Definition: Denotes if ward uses cart system of supply distribution: code 1 if the ward is on the cart system, code 0 otherwise.

10 PARLONG- PAR SYSTEM LENGTH OF TIME

Data Source: BAMC Wardmaster Survey

Variable Units: Days

Variable Definition: Average Number of days it takes to receive medical supplies in the "non-cart level systems" after submission of the requisition.

DATA COLLECTION

Data were collected for monetary and personnel variables from information provided by administrative sources within the organization. Monetary data were received from the Resource Management Division (RMD) and nursing personnel information was compiled from daily nursing activity reports and standard financial reports. The Workload Management System data (including acuity and patient numbers) came from routine reports used within the Department of Nursing (including data from UCAPERS and AQCESS).

The data which were used in this study regarding the time spent on supply activities was extracted from surveys of the hospital wards. At the

beginning of the study, all wardmasters were called together in a meeting and the purpose of the study was discussed. A survey instrument was handed out and the parameters of the data collection process were discussed in open forum. The discussion included which activities should be considered as requisitioning time, stocking time and other time. A question and answer period was used to allow all personnel the opportunity to clarify any doubts about the requirements.

During the period of data collection by the wardmasters, I made no contact with the ward personnel. After the information was collected, a second meeting was held for the wardmasters to turn in their data sheets. Each wardmaster was interviewed when they turned in their data to ensure that the surveys were filled out properly.

The validity and reliability of this study depends on the quality of the data used in the compilation of: 1. the workload management system for nurses, 2. the uniform chart of accounts for personnel (UCAPERS) and 3. the fiscal management information used by the resource management division at BAMC. In order to assure accurate interpretation of the source documents, all reports were reviewed with the respective sources to ensure correct data were extracted for this project.

III. RESULTS

Normal parametric statistical analysis was accomplished in the quantitative analysis of this project. Descriptive statistical analysis was

performed and included the calculation of means and standard deviations. After analysis of the descriptive statistics, inferential statistics were performed using correlation analysis. The alpha level of significance was set at .05 ($\alpha = .05$). Twenty wards were examined for three different types of cost and three different types of time. This resulted in 60 data points for both the *time and cost* dependent variables. It was determined that there was a statistically significant difference in the time spent by nursing depending on the type of supply distribution system being used. There was no statistically significant difference in the amount of money spent on supplies as a function of the type of supply distribution system being used. Descriptive statistics for nursing time and money spent on supplies can be found at Table 1. As shown, about 40% of the wards (.40) were using the cart system.

Insert Table 1 about here

Since there was a significant difference in the amount of time spent based on the supply distribution system in use, the data for the dependent variable of TIMTOT were broken out into the three sub-variable categories and partitioned into the "general supply system" (GSS) and "cart system"

categories. At table 2, you will find the units of measure to be both the average number of man-hours per month and the *delta* value re-expressed as the number of man-days per month.

Insert Table 2 about here

IV. DISCUSSION

Hypothesis #1- There was not a significant difference in the amount of money spent for supplies based on whether the ward uses the cart system or uses the general supply system ($r = .03$, $p > .05$). Therefore, the alternate hypothesis is rejected. Because of this finding, we can conclude that conversion of the existing GSS wards in the medical center can be accomplished without a major impact on the finances of the organization. Management gains flexibility by allowing decisions of medical supply delivery systems for wards without having to be concerned about potential financial impacts.

Hypothesis #2- There was a significant difference in the amount of time spent on supply operations based on the type of material distribution system being used ($r = -.37$, $p < .05$). Therefore, the alternate hypothesis is accepted. With a significant correlation in this hypothesis, personnel staffing actions can be affected allowing the Department of Nursing to redistribute personnel assets in order to maximize their limited support

capabilities.

The end user of the supply system on a ward is typically an NCO or junior enlisted soldier. As a user of the General Supply System (GSS), these individuals are responsible for ordering, stocking and tracking the expendable supplies used on the ward. The empirical data from this study indicates that these BAMC personnel spend approximately one day a week in the supply process.

The information at Table 2 shows that in the General Supply System, 7.82 man-hours a month are spent in the requisition process, 16.06 man-hours per month are spent in the stocking process and 11.87 man-hours per month are spent in other activities (including making telephone calls to check on the status of orders, driving time to pick up supplies, etc.). By converting to the Cart Delivery System (MDS), wards in the Main Hospital can save many man-hours of work. Table 2 shows that the difference in total time spent between the two systems amounts to 2.83 man days/month per ward. This represents almost three additional man-days per month of trained nursing personnel which can be used to offset current nursing contracting hours (money spent to hire outside help). In other words, the financial savings from the conversion to the Cart system will equate to the dollar amount of 3 man-days of contract nursing money for every ward that is converted. Even after hiring additional personnel in logistics (wage grade employees) to handle the increased workload, there would still be

substantial savings to the medical center.

In conducting this study, I became aware of the complexity of the systems used in the delivery of medical supplies to the various wards within Brooke Army Medical Center. There are separate supply systems for "Beach" and "Main" and, within each hospital, there are separate systems for the delivery of supplies to specialty wards. To compound the problem even further, there are different supply accountability systems for drugs and supplies based on their pilferability and abuse potential.

The supply systems used at BAMC must be able to function independently at the lower levels of the organization yet provide comprehensive, reliable and valid data at the top of the organization's structure. For example, wards should be able to request and receive materials from the Central Material System (sterilized material) without having to go through the General Supply System channels. This makes the restocking of selected sterile supplies on the wards independent from other activities (like ordering emesis basins). Conversely, there must be a marriage of the administrative data at the C, Logistics level to ensure all supplies are accounted for, the correct wards are charged for their purchases and the accurate information is routed through the resource management division and charged to the appropriate account.

According to the findings of this study, the GSS end user should be attuned to the administrative procedures of the logistics system in order to

gain the best fiscal advantage and increase the responsiveness of the system. When the quantitative analysis was performed for this project, it was found that there was a statistically significant difference between the total amount of time the ward spent in the "requisition phase" and the total amount of time spent in the overall supply process. The analysis showed that the total time spent in the supply process varied inversely as a function of the amount of time spent requisitioning materials ($r = -.24$, $p < .05$). In other words, the more time you spend filling out the requisitions and paying attention to detail at the beginning of the supply process, the less time you will spend tracking down the status of your orders and the less total time you will spend in supply activities.

During the 3rd quarter of FY93, an internal review was initiated to investigate the procedures in use at MDS. Several questions were raised regarding the quality of the software program used in the automation of the cart system due to numerous deficiencies in the program including: 1. an inability to make ad-hoc inquiries and 2. questionable accounting mechanisms for posting corrections to stockage levels. In the audit, it was discovered that in a few instances, there were discrepancies which showed a different "on-hand" balance on the shelves than were on the automated books. The software also produced monthly MDS summary reports with ending inventory totals that did not agree with the calculations of the Auditor (Beers, 1993). This investigation is on-going.

OTHER FINDINGS:

In the quantitative evaluation of the data in this study, several significant correlations were found among the independent variables which were analyzed. These included various aspects of the internal operations of the Department of Nursing including WMSN, pt. acuity etc.

The total amount of money spent on a ward (MONTOT) showed significant correlations with several independent variables (see table 1). There were statistically significant correlations between dollars spent and the acuity of the patient ($r = .33, p < .05$), WMSN required ($r = .27, p < .05$), nursing care hours ($r = .27, p < .05$), professional FTE's ($r = .33, p < .05$), and paraprofessional FTE's ($r = .28, p < .05$).

Another interesting finding dealt with the workload management system for nurses and how it related to the actual staffing patterns in the hospital. The WMNS is designed to serve as the basis for staffing nurses throughout the organization. Often, WMSN is sometimes only used as a general guideline and staffing is determined on "turf" matters and political gamesmanship. This sometimes becomes detrimental to the operation of the organization because resources are not distributed in an objective manner. In this study, I found that the BAMC Department of Nursing was following the WMSN system at almost a perfect correlation level ($r = .98, p < .01$).

V. CONCLUSIONS AND RECOMMENDATIONS

NEW BAMC:

During my literature review, I discovered that the evolution of medical supply distribution systems is driven largely on technological advances. For example, when bar coding became available, the new paperless supply systems became feasible. I also discovered that the "popular" opinion about the preferred delivery system changes from year to year. These trends highlight the importance of building flexibility into the new Brooke Army Medical Center. While we are in the construction phase, we should consider all possible structural modifications which will allow the implementation of many different systems. I make the following recommendations regarding the new BAMC project:

1. Plan for the implementation of the Cart system.
2. Identify space requirements for the use of the Cart system.
3. Purchase carts with construction money rather than normal supply funds.
4. Study the current cart system and develop implementation plans and recommendations for the transition to the new facility.
5. Identify the shortcomings in the MDS automation system.
6. Visit Army Hospitals who currently use the Cart System and develop a lessons learned file.

7. Develop standing operating procedures incorporating lessons learned.

8. Identify one individual with responsibility for the cart system.

CURRENT OPERATIONS:

While in the current facility, BAMC should convert selected wards to the cart system. The empirical data indicates that cost savings can be gained by the shift of workload from nursing personnel to wage grade employees. Since there is no significant difference in the amount of money spent as a function of the type of system used, there is little fiscal risk in making the change. I recommend the following:

1. INCREASE EFFICIENCY OF CURRENT SYSTEM

- Investigate current MDS operations and implement changes to current automation system.**
- Gradually convert selected wards to cart system in concert with the recommendations of the DON**
- Emphasize the benefits of correctly requisitioning supplies**

2. RECOMMENDATIONS FOR FURTHER STUDY

- Weight/movement studies should be conducted in MDS to determine the most cost effective mechanism for determining when a cart is empty enough to move.**
- Time and Motion studies should be performed for the**

individuals who stock the carts to increase efficiency.

-Satisfaction studies should be performed to assess the impact of the change to the cart system.

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TABLE 1: Descriptive Statistics for all Wards

	Mean	Std Dev	Time r	\$ r
TIME SPENT (min/mo)				
Requisition time	246.80	266.19	*-.24	
Stocking Time	474.10	497.86	.12	
Other (calls, followup, etc.)	479.90	520.05	.12	
TOTAL	400.27	449.13		
DOLLARS SPENT (\$K/mo)				
Material Distribution System	2.84	4.99		-.03
Logistics General Supply System	5.61	6.49		*.36
Central Material System	.67	.69		*-.33
TOTAL	3.04	5.09		
Wards on Cart System (1=yes; 0=no)	.40	.49	*-.37	.03
Number of Beds	20.65	9.46	.11	-.20
Acuity (0-6)	2.99	1.06	.15	*.33
WMNS Required	31.50	9.81	.03	*.27
Nursing Care Hours	140.09	49.65	.05	*.27
Staff (FTE)				
Professional	11.12	9.32	.22	*.33
Paraprofessional	10.55	4.77	.19	*.28
* p< .05 n= 20 Wards				

TABLE 2: Nursing Time Spent on Supplies

	<i>Wards on CART (avg mh/mo)</i>	<i>Wards on GSS(avg mh/mo)</i>	<i>Δ CART vs. GSS (mh/mo)</i>	<i>Δ CART vs. GSS (man days/mo) <small>based on 8 hr day</small></i>
REQUISITION TIME	1.99	7.82	5.83	.73
STOCKING TIME	2.25	16.06	13.81	1.72
OTHER	8.86	11.87	3.01	.38
<u>TOTAL=</u>	13.10	35.74	22.65	2.83

VENDOR DISTRIBUTION SYSTEMS:

- 1. Consignment System**
- 2. Just-in-time System (JIT)**
- 3. Stockless Inventory System**
- 4. Prime-Vendor Concept**

AUTOMATIC REPLENISHMENT SYSTEMS:

- 1. Periodic Automatic Replenishment Systems (PAR)**
- 2. Cart-Exchange System**

Source: HCAB (1992)

Figure 1. Major Categories of Supply Distribution Systems

<i>CATEGORY</i>	<i>POINT RANGE</i>	<i>DIRECT CARE DESCRIPTION</i>
0	0	Patient is on Pass
I	0-12	Self care/minimum care
II	13-31	Moderate Care
III	32-63	Acute Care (1 staff to 3 patients)
IV	64-95	Intensive Care (1 staff to 2 patients)
V	96-145	Continous Care (1 staff to 1 patient)
VI	146-256	Critical Care (>1 staff to 1 patient)
		<small>Source: Army Field Manual FM 8-501 (November, 1990)</small>

Figure 2. Patient Acuity Categories